(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 933 163 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
04.08.1999 Bulletin 1999/31

(51) Int Cl.6: B24B 13/005

(21) Application number: 99101573.6

(22) Date of filing: 29.01.1999

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: 30.01.1998 JP 3403598
31.08.1998 JP 24621398

(71) Applicant: NIdek Co., Ltd.
Gamagori-shi, Aichi (JP)

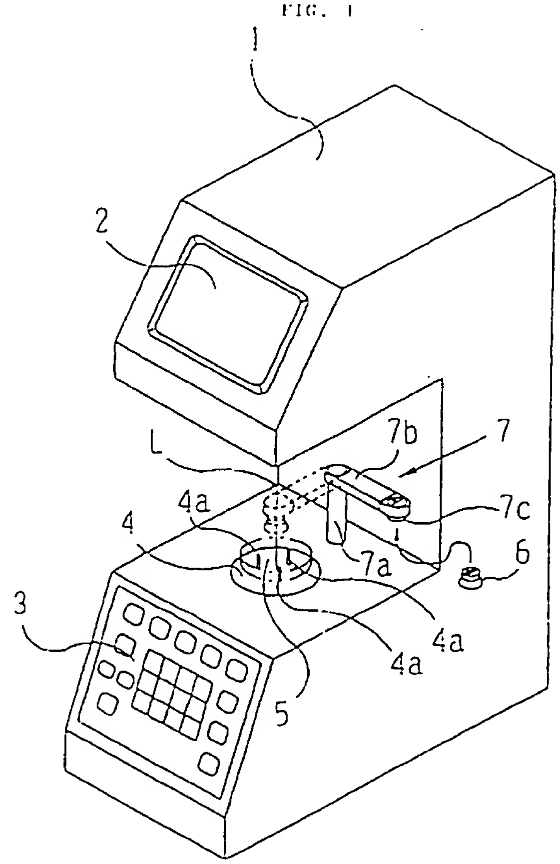
(72) Inventor: Mizuno, Toshiaki
Gamagori-shi, Aichi (JP)

(74) Representative: Weber, Joachim, Dr.
Hoefer, Schmitz, Weber
Patentanwälte
Gabriel-Max-Strasse 29
81545 München (DE)

(54) Cup attaching apparatus

(57) In a cup attaching apparatus, a cup (6) is attached as a processing jig to a subject lens (5) along a reference axis (L), the lens (5) and an index plate (14) having an index of a predetermined pattern are illuminated by substantially parallel rays of light shaped into a diameter larger than a diameter of the lens (5) so that an image of the lens (5) and an image of the index are projected onto a screen (2), and the index image projected onto the screen (2) is detected, whereas an entire image of the lens projected onto the screen (2) is picked up. An optical center of the lens (5) with respect to the reference axis (L) is obtained on the basis of the index image detected by said detecting means, thereby displaying in a superposed manner alignment information indicating a relative position of the optical center with respect to the reference axis (L) and the image thus picked up. The alignment is effected while observing the displayed information.

FIG. 1



EP 0 933 163 A1

Printed by Jouve, 75001 PARIS (FR)

Description

BACKGROUND OF THE INVENTION

Field of the Invention:

[0001] The present invention relates to a cup attaching apparatus for attaching a cup as a processing jig to a subject lens which is processed by an eyeglass lens processing apparatus. Description of the Related Art:

[0002] When a subject lens is ground by a processing apparatus, a cup (a suction cup, a cup which is fixed with a pressure sensitive adhesive sheet placed in between, or the like) as a processing jig is attached to the subject lens by means of a cup attaching apparatus as a preliminary-step operation. Conventionally, the cup attaching operation is generally performed as follows.

[0003] In cases where the subject lens is a unifocal lens, the lens is first marked with a marked point in alignment with the optical center and the angle of the cylinder axis of the subject lens by using a lens meter. Subsequently, the subject lens is moved to the cup attaching apparatus, the marked point and a reference scale on the subject lens illuminated by an illuminating means are projected onto a screen, and while observing them, positioning is effected so that the reference scale and the marked point assume a predetermined relationship, and the cup is attached.

[0004] In addition, in the case of multifocal lenses such as a progressive multifocal lens and a bifocal lens, layout marks provided on the lens surface and a small lens portion of the lens are projected onto a screen, positioning is effected on the basis of the projected images and a reference scale, and the cup is attached.

[0005] However, with the method using the above-described conventional apparatus, the lens meter and the cup attaching apparatus are required for attaching the cup to the unifocal lens, so that this method is disadvantageous in terms of the installation space and economic efficiency. In addition, the respective apparatuses must be operated, so that the operating efficiency is poor.

[0006] Further, on the cup attaching apparatus side, an alignment operation for effecting positioning in conformity with the marked point is required, it is not easy for a person unskilled in the operation to speedily perform the positioning with high accuracy. The poor positioning accuracy leads to an error at the time of processing. Particularly in processing centers where subject lenses are processed in a concentrated manner, there has been a demand for controlling the occurrence of processing errors due to cup attachment and for improving the operating efficiency as much as possible.

[0007] Furthermore, when the cup is attached to the subject lens, confirmation is necessary as to whether or not the lens diameter is sufficiently large enough for an eyeglasses frame into which the lens is fitted, but this confirmation operation has not been easy.

SUMMARY OF THE INVENTION

[0008] In view of the above-described problems, it is an object of the present invention to provide an apparatus which makes it possible to efficiently perform the cup attaching operation by facilitating the alignment for attaching the cup without performing the marking operation on the subject lens, and which makes it possible to easily confirm processability.

[0009] To attain the above-noted object, the present invention provides the following.

(1) A cup attaching apparatus comprising:

attaching means having a reference axis to attach a cup as a processing jig to a subject lens along the reference axis;
illuminating means for illuminating the lens and an index plate having an index of a predetermined pattern by means of substantially parallel rays of light:
index detecting means for detecting an image of the index formed by said illuminating means;
optical-center sensing means for obtaining an optical center of the lens with respect to the reference axis on the basis of a result of detection by said index detecting means; and
position storing means for storing information on a position of the optical center obtained by said optical-center sensing means when said cup is attached to the lens by said attaching means,
wherein the information on the position of the optical center stored by said storage means is used as information on correction at the time of processing by an eyeglass lens processing apparatus.

(2) The cup attaching apparatus according to (1), wherein the index includes a grid index.
(3) The cup attaching apparatus according to (1), further comprising:

shape storing means for storing a shape of the cup which is attached to the lens;
input means for inputting data on a shape of an eyeglasses frame into which the lens is fitted and data on layout of the lens with respect to the eyeglasses frame; and
display means for displaying alignment information for avoiding processing interference, on the basis of the cup shape stored by said shape storing means, the frame shape based on the data inputted by said input means, and a relative position of the optical center obtained by said optical-center sensing means with respect to the reference axis.

(4) The cup attaching apparatus according to (3), wherein said display means displays the cup shape in such a manner as to have a predetermined positional relationship with the reference axis, and displays the frame shape such that an optical center of the frame shape is located at the position of the optical center obtained by said optical-center sensing means.

(5) The cup attaching apparatus according to (4), further comprising:

reticle forming means for forming on display by said display means a reticle for alignment having a predetermined positional relationship with the reference axis; and
graphic-figure forming means for forming a graphic figure indicating a position of the optical center or a frame center of the frame shape.

(6) The cup attaching apparatus according to (3), wherein said display means displays a region for aligning the optical center obtained by said optical-center sensing means with respect to the reference axis.

(7) The cup attaching apparatus according to (3), wherein said display means displays a region for aligning the optical center obtained by said optical-center sensing means with respect to the reference axis,

said cup attaching apparatus further comprising:
reticle forming means for forming on display by said display means a reticle for alignment having a predetermined positional relationship with the reference axis; and
graphic-figure forming means for forming a graphic figure indicating a position of the optical center or a frame center of the frame shape.

(8) The cup attaching apparatus according to (1), further comprising:

cylinder-axis sensing means for obtaining a direction of a cylinder axis of the lens on the basis of a result of detection by said index detecting means;
input means for inputting data on an angle of the cylinder axis obtained by prescription;
displacement detecting means for obtaining information on displacement in a direction of the cylinder axis obtained by said cylinder-axis sensing means with respect to the angle of the cylinder axis inputted by said input means; and
displacement storing means for storing the displacement information obtained by said displacement detecting means when the cup is attached to the lens by said attaching means,
wherein the displacement information stored by said displacement storing means is also used as information on correction at the time of processing by said eyeglass lens processing apparatus.

(9) The cup attaching apparatus according to (1), further comprising:

cylinder-axis sensing means for obtaining a direction of a cylinder axis of the lens on the basis of a result of detection by said index detecting means;
input means for inputting data on an angle of the cylinder axis obtained by prescription; and
display means for displaying information on the direction of the cylinder axis obtained by said cylinder-axis sensing means and information on the angle of the cylinder axis inputted by said input means,
wherein alignment in the direction of the cylinder axis is effected while observing display by said display means.

(10) The cup attaching apparatus according to (1), further comprising:

a screen for projecting an image of the lens formed by said illuminating means;
imaging means for picking up an entire image of the lens projected onto said screen;
input means for inputting data on a shape of an eyeglasses frame into which the lens is fitted and data on layout of the lens with respect to the eyeglasses frame;
display means for displaying in a superposed manner the image picked up by said imaging means and a frame shape based on the data inputted by said input means; and
display controlling means for controlling display on the frame shape such that an optical center of the frame shape is located at the position of the optical center obtained by said optical-center sensing means.

(11) The cup attaching apparatus according to (1), further comprising:

a screen for projecting an image of the lens formed by said illuminating means;
imaging means for picking up an entire image of the lens projected onto said screen;
display means for displaying the image picked up by said imaging means;
display controlling means for controlling display by said display means for displaying a reticle having a predetermined relationship with the reference axis; and

selecting means for selecting a type of the lens, wherein when a progressive multifocal lens is selected by said selecting means, said display controlling means causes an image of a layout mark of the progressive multifocal lens to be displayed on the display by said display means, and alignment is effected while observing the layout mark image and the reticle displayed by said display means.

(12) The cup attaching apparatus according to (1), further comprising:

a screen for projecting an image of the lens formed by said illuminating means;
imaging means for picking up an entire image of the lens projected onto said screen;
display means for displaying the image picked up by said imaging means;
input means for inputting data on layout of the lens with respect to an eyeglasses frame;
selecting means for selecting a type of the lens; and
display controlling means for controlling display by said display means for displaying a small lens mark for aligning a small lens of a bifocal lens on the basis of the layout data inputted by said input means when the bifocal lens is selected by said selecting means,
wherein alignment is effected while observing the small lens mark and an image of the small lens displayed by said display means.

[0010] The present disclosure relates to the subject matter contained in Japanese patent application Nos. Hei. 10-34035 (filed on January 30, 1998) and Hei. 10-246213 (filed on August 31, 1998), which are expressly incorporated herein by reference in their entireties.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011]

Fig. 1 is an external view of the apparatus in accordance with a first embodiment;
Fig. 2 is a diagram illustrating an optical system of the apparatus in accordance with the first embodiment;
Fig. 3 is a diagram illustrating a controlling system of the apparatus in accordance with the first embodiment;
Fig. 4 is a diagram illustrating the offset of the central position of a ring image projected onto a screen plate when the subject lens is mounted;
Fig. 5 is a diagram illustrating the ring image projected onto the screen plate when the subject lens has cylindrical refractive power;
Figs. 6A and 6B are diagrams explaining the intended lens shape and the subject lens which are displayed on a monitor in a unifocal lens;
Fig. 7 is a diagram explaining the intended lens shape and the subject lens which are displayed on the monitor in a progressive multifocal lens;
Fig. 8 is a diagram explaining the intended lens shape and the like which are displayed on the monitor in a bifocal lens;
Fig. 9 is an external view of the apparatus in accordance with a second embodiment;
Fig. 10 is a diagram schematically illustrating the configuration of an optical system of the apparatus in accordance with the second embodiment;
Fig. 11 is a diagram illustrating a controlling system of the apparatus in accordance with the second embodiment;
Fig. 12 is a diagram illustrating a method for detecting the optical center of the subject lens from an index image;
Fig. 13 is a diagram illustrating an example of the monitor in the unifocal lens;
Fig. 14 is a diagram illustrating an example of the monitor in a multifocal lens; and
Fig. 15 is a diagram illustrating an example of the monitor in the bifocal lens.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

First Embodiment

[0012] Referring now to Figs. 1 to 8, a description will be given of a first embodiment of the present invention. Fig. 1 is an external view of the apparatus in accordance with the first embodiment of the present invention. Reference numeral 1 denotes an apparatus main body having substantially U-shaped side surfaces, and an illuminating optical system and an imaging optical system shown in Fig. 2 are disposed therein. A monitor 2 such as a liquid-crystal display is provided on an upper front surface of the main body 1, and a switch panel 3 is provided on a lower front surface. Displayed on the monitor 2 are an image of a subject lens 5 which is imaged by a CCD camera, which will be described later, a mark for alignment, a layout screen, and the like.

[0013] Numeral 4 denotes a mounting portion for mounting the lens 5. The bottom of the mounting portion 4 is formed of a transparent member so that illumination light from above passes through the lens 5 and reaches a screen plate 15 (see Fig. 2) inside the main body 1. Three lens supporting portions 4a are embedded in the mounting portion 4 at equal intervals with a reference axis L as a center, thereby supporting the lens 5 stably without tilting. Distal ends of the supporting portions 4a are formed of a material such as a soft synthetic resin so as not to damage the lens 5.

[0014] Numeral 7 denotes a lens attaching portion for

attaching a cup 6 to the lens. The attaching portion 7 is comprised of a motor 31 provided inside the main body 1, a shaft 7a which rotates and moves vertically by means of a motor 32 (see Fig. 3), and an arm 7b fixed to the shaft 7a. An attaching portion 7c for fitting a proximal portion of the cup 6 is provided on the underside of a distal end of the arm 7b. The cup 6 is attached in a predetermined direction in accordance with a positioning mark provided on an upper surface of the arm 7b. When the arm 7b rotates to the position indicated by the dotted lines in conjunction with the rotation of the shaft 7a, the center of the cup 6 is adapted to arrive at the reference axis L. It should be noted that the cup 6 may be of a type in which it is sucked onto the surface of the lens 5 or a type in which it is fixed with a pressure sensitive adhesive sheet placed in between.

[0015] Fig. 2 is a diagram illustrating a schematic configuration of the optical system inside the main body 1. Numeral 10 denotes an illuminating light source for illuminating the lens 5. The illuminating light from the light source 10 passes through reflecting mirrors 11 and 12, is converted into parallel rays of light having a larger diameter than that of the lens 5 by means of a collimator lens 13, and is then transmitted through an index plate 14. A ring index with its center set on the reference axis L is formed on the index plate 14, and the illuminating light including the ring index beam illuminates the lens 5 from above along the reference axis L.

[0016] Numeral 15 denotes the screen plate formed of a semitransparent material (e.g., ground glass), and an image of the lens 5 illuminated by the illuminating light from above as well as an image of the ring index which passed through the lens 5 are projected onto the screen plate 15. The images projected onto the screen plate 15 are imaged from the rear by a CCD camera 17 having an imaging lens through a mirror 16, and are displayed on the monitor 2.

[0017] Further, the screen plate 15 is movable between a position A in the vicinity of the mounting portion 4 in Fig. 2 and a position B spaced apart a predetermined distance therefrom by means of a screen driving motor 33 (see Fig. 3). In multifocal lenses such as a bifocal lens and a progressive lens, since positioning is effected on the basis of projected images of the layout marks provided on the lens and the small lens portion (which will be described later) the screen plate 15 is disposed at the position A so as to minimize the distortion of the projected image due to the refractive power of the lens 5. In the unifocal lens, on the other hand, since the optical center and the axial direction of cylindrical refractive power are determined on the basis of the displacement of the ring image due to the refractive power of the lens (which will be described later), the screen plate 15 is disposed at the position B spaced apart from the lens 5 so as to facilitate the detection of the displacement of the ring image.

[0018] In addition, the CCD 17 is also movable in the direction of the arrow (in the direction of the imaging optical axis) by means of a camera driving motor 39 (see Fig. 3), and at the same time as the screen plate 15 moves from the position A to the position B, the CCD 17 also moves from the position A' to the position B', thereby focusing the image projected onto the screen plate 15.

[0019] Fig. 3 is a diagram illustrating a controlling system of the apparatus. An image signal from the CCD 17 is inputted to an image synthesizing circuit 35, and the circuit 35 combines the image signal with characters and marks generated by a display circuit 36 connected to a control unit 30, and displays the same on the monitor 2. The image signal from the CCD 17 is inputted to an image processing circuit 34 as well. The circuit 34 detects the position of the ring image projected onto the screen plate 15 through the lens 5, and inputs the detected signal to the control unit 30. On the basis of the detected signal, the control unit 30 obtains the offset of the central position of the ring image projected onto the screen plate 15 in correspondence with the mounted position of the lens 5, i.e., the amount of displacement of the position of the optical center, as shown in Fig. 4. When the lens 5 has cylindrical refractive power, the ring image projected onto the screen plate 15 changes into an elliptical shape a shown in Fig. 5, so that the angle of the cylinder axis is obtained on the basis of the inclination (in the direction of the long axis) of the elliptical shape. In addition, the angle of the cylinder axis may be alternatively determined from the short axis direction of the ellipse.

[0020] Furthermore, also connected to the control unit 30 are the motor 31 for rotating the shaft 7a of the attaching portion 7, the motor 32 for vertically moving the shaft 7a, the motor 33 for moving the screen 15, a frame-shape measuring device 37 for measuring the shape of an eyeglasses frame, a processing apparatus 38 for grinding the lens 5, the motor 39 for moving the CCD 17, a memory 40 for storing the inputted data and the like, and the switch panel 3.

[0021] A description will be given of the operation of the apparatus having the above-described configuration. First, the shape of the eyeglasses frame into which the lens 5 is fitted is measured in advance by the measuring device 37, and its data is inputted. The inputted frame data is stored in the memory 40, and an intended lens shape (a target lens configuration) 20 based on the inputted frame data is displayed on the monitor 2 (the intended lens shape for the right eye is initially displayed). The operator inputs frame-fitting conditions, including the layout of the lens with respect to the frame shape and the type of the lens, by operating the switch panel 3. The type of the lens is selected by a MODE key 3a. Hereafter, a description will be given of cases where the types of the lenses to be processed are a unifocal lens, a progressive multifocal lens, and a bifocal lens, respectively.

<Unifocal Lens>

[0022] In the unifocal lens mode, the optical center mode for axially positioning the cup at the optical center of the lens and the frame center mode for axially positioning the cup at the geometric center of each eyeglasses frame portion can be further selected by the key 3a.

(A) Optical Center Mode

[0023] Since input items for the layout of the lens are displayed on the left-hand side of the screen of the monitor 2, a highlighted cursor 21 is moved by a cursor moving key 3b to select Items to be inputted. The values of the input items can be changed by a "+" "-" key 3c or a ten-key pad 3d, and layout data including FPD (the distance between geometric centers of both eyeglasses frame portions), PD (pupillary distance), and U/D (the height of the optical center with respect to the geometric center of each eyeglasses frame portion) are inputted. In addition, a cross reticle 22 having a center at the position aligned with the reference axis L is displayed on the screen of the monitor 2, and the intended lens shape (the target lens configuration) 20 and an intended lens center 20a are displayed after being moved with respect to the center of the reticle 22 on the basis of the inputted layout data.

[0024] When the lens 5 has astigmatic power, the cursor 21 is moved to an item AXIS, and the axial angle in the prescription is inputted in advance. An AXIS reticle 23 corresponding to the inputted axial angle is displayed on the monitor 2.

[0025] Incidentally, this layout data may be transferred to the processing apparatus 38, and the type of the lens 5 (the type such as plastics and glass) and the type of the eyeglasses frame may be inputted in advance by a LENS key 3e and a FRAME key 3f, respectively, so that processing can be performed directly by using the layout data.

[0026] When necessary inputs have been made, an ENTER key 3g is pressed. In the case of the unifocal lens mode, the control unit 30 causes the screen plate 15 and the CCD 17 to move to the positions B and B', respectively, by operating the motors 33 and 39.

[0027] When the setting of the apparatus is completed, the operator mounts the lens 5 on the mounting portion 4, and performs adjustment for centering. When the lens 5 is mounted on the mounting portion 4, images of the lens 5 and a ring index beam which passed it are projected onto the screen plate 15, and are imaged by the CCD 17. In the case of the unifocal lens mode, the control unit 30 continuously obtains the amount of offset of the position of the optical center from the reference axis L and the axial angle of cylindrical refractive power on the basis of the position detected signal of the ring image detected by the circuit 34. As shown in Fig. 6A, a target 24 indicating the optical center and an AXIS target 25 are displayed by the circuit 36 based on information of the amount of offset of the position of the optical center and the axis angle which the control unit 30 obtained. While viewing this display, the operator moves the lens 5 in such a manner that the center of the target 24 coincides with the center of the reticle 22, thereby effecting the positioning of the optical center of the lens 5 with respect to the reference axis L. Further, the lens 5 is rotated in such a manner that the inclination of the target 25 is aligned with the reticle 23, thereby adjusting the axial angle of the lens to the angle of astigmatic axis in the prescription. When the optical center of the lens 5 and the axial angle are aligned, if the shapes of the targets 24 and 25 are changed and the operator is notified to that effect, ease of use is further facilitated.

[0028] After the centering is thus completed, that state is kept intact, and a LAYOUT key 3h is pressed. The control unit 30 causes the screen plate 15 to move from the position B to the position A in the vicinity of the mounting portion 4, and moves the CCD 17 to the point A'. As a result, the an outside diameter contour image of the lens 5 projected onto the screen plate 15 is projected as a real size substantially without being affected by its refractive power. By observing a lens image 5' and the intended lens shape (the target lens configuration) 20 which are displayed on the monitor 2 (see Fig. 6B), the operator is able to easily determine processability as to whether or not the lens diameter is lacking for processing. Incidentally, when the lens diameter is clearly sufficient for the frame shape, the screen plate 15 may not necessarily be moved.

[0029] If there is no problem with the diameter of the lens 5, a BLOCK key 3i is pressed. The control unit 30 drives the motor 31 to rotate the shaft 7a so that the cup 6 fitted in advance on the attaching portion 7 arrives at the reference axis L, and the control unit 30 then drives the motor 32 to lower the cup 6, and allows the cup 6 to suck the lens 5.

(B) Frame Center Mode

[0030] A brief description will be given of portions which differ from the case of the optical center mode. It should be noted that it is advisable to employ the frame center mode when the amount of moving over is large in the optical-center layout, and the so-called processing interference occurs on the processing apparatus 38 side.

[0031] In the same way as in the optical center mode, the layout data, including FPD, PD, and U/D, and the axial angle of astigmatism are entered. The display of the intended lens center 20a is fixed as aligned with the reference axis L, and the reticle 22 and the reticle 23 are displayed at the positions where they are moved on the basis of the inputted layout data. The target 24 which is displayed when the lens 5 is mounted on the mounting portion 4 is aligned with the reticle 22, thereby performing the centering adjustment. In the case of a lens having cylindrical refractive power, after the target 25 dis-

played in the same way as in the optical center mode is aligned with the reticle 23, the cup 6 is attached. It should be noted that, in this case as well, if the screen plate 15 is moved in advance to the position A before the attachment of the cup 6, it is possible to easily determine the processability by observing the lens image 5' and the intended lens shape (the target lens configuration) 20.

<Progressive Multifocal Lens>

[0032] A description will be given of the case of the progressive multifocal lens. In the progressive multifocal lens mode, the screen plate 15 is disposed at the position A. In the same way as described above, the layout data is entered by using the respective keys on the panel 3. In the progressive multifocal lens mode, the reticle 22 is displayed fixedly with its center aligned with the reference axis L, and the displayed positions of the intended lens shape (the target lens configuration) 20 and the intended lens center 20a change in correspondence with the inputted layout data. Incidentally, the frame center mode may also be provided in the same way as with the unifocal lens.

[0033] Since the progressive multifocal lens in the state supplied from a lens manufacturer is provided with the layout marks indicating such as an eyepoint for far use and the horizontal direction, the centering adjustment is effected while observing the layout mark images which are projected onto the screen plate 15 and displayed on the monitor 2. Fig. 7 shows an example of the screen at this time, in which reference numeral 50 denotes an image of the eyepoint mark for far use, and numeral 51 denotes an image of the horizontal line mark. The eyepoint mark for far use and the horizontal line mark are clearly displayed by being projected onto the screen plate 15. After the operator completes centering adjustment by moving the lens such that the mark image 50 and the mark image 51 are superposed on the reticle 22, the operator allows the cup 6 to suck the lens.

<Bifocal Lens>

[0034] In this mode, the screen plate 15 is disposed at the position A. As shown in Fig. 8, in the bifocal lens mode, a small lens portion layout mark 45 is displayed in addition to the intended lens shape (the target lens configuration) 20. The layout data is entered by operating the panel 3 in accordance with the input items shown on the left side. In an item 200, the pupillary distance for near use is entered. In an item 201, the distance from the center of the upper line of the small lens portion to the bottom side of the intended lens shape immediately therebelow (that is to say, the height of the small lens portion) is fitted is entered. As a result, an upper center position 45a of the mark 45 is determined by using the intended lens center 20a as a reference.

[0035] The axial positioning of the bifocal lens is performed as follows. When the lens 5 is mounted on the mounting portion 4, a projected image obtained by the illuminating light is displayed on the monitor 2, and the small lens portion of the lens 5 is clearly displayed by being projected onto the screen plate 15. The lens 5 is moved in such a manner that a displayed image 52 of the small lens portion is superposed on the mark 45, and positioning is effected in such a manner that the upper center of the small lens image 52 is superposed on the upper center portion 45a of the mark 45. This completes the axial positioning, so that after confirming the processability by comparing the intended lens shape 20 and the lens image 5', the key 3i is pressed to attach the cup.

[0036] Although in this embodiment the screen plate 15 is moved to two locations, the screen plate 15 may be moved vertically without steps and may be stopped at such a position that allows the optical center to be determined easily.

[0037] Further, a mechanism which allows the index plate 14 to move into and away from the optical path may be provided, and the index plate 14 may be moved away from the optical path when the detection of the position of the optical center is not required as in the case of a multifocal lens. If such an arrangement is adopted, when the image of the lens is observed to make positional adjustment, an image of the index does not come in the way and is easy to observe.

[0038] Further, although in this embodiment the index plate 14 is disposed between the light source 10 and the lens 5, the present invention is not limited to the same, and the index plate 14 may be disposed between the lens 5 and the screen plate 15, or the mounting plate 4 may be used to serve as the index plate 14.

Second Embodiment

[0039] Referring now to Figs. 9 to 15, a description will be given of a second embodiment of the present invention. Fig. 9 is an external view of the apparatus in accordance with the second embodiment of the present invention, and Fig. 10 is a diagram illustrating a schematic configuration of an optical system in the apparatus. Reference numeral 101 denotes an apparatus main body having substantially U-shaped side surfaces, and an illuminating optical system and an imaging optical system shown in Fig. 10 are disposed therein. A monitor 102 such as a liquid-crystal display is provided on an upper front surface of the main body 101, and a switch panel 103 is provided on a lower front surface. Displayed on the monitor 102 are an image of a subject lens LE which is imaged by a CCD camera, which will be described later, a mark for alignment, a layout screen, and the like.

[0040] Numeral 105 denotes a screen plate made of semitransparent or translucent material (for instance, frosted or grounded glass). Three lens supporting por-

tions 104 are implanted or projectingly provided on the screen plate 105 at equal angular intervals about a reference axis L so as to place the lens LE thereon. Each of the lens supporting portions 104 has such a length that the lens LE is distanced about 15mm from the screen plate 105 when the lens LE is placed. An index plate 114 on which a prescribed pattern is formed is mounted to the supporting portions 104a so as to be located below the lens LE when the lens LE is placed. The index plate 114 in this embodiment is constructed by a transparent glass plate on which black dots are provided at 0.5mm pitches in an square area of 20mm x 20mm about the reference axis L to define a grid index. The index plate 114 may be disposed on the illumination light source side with respect to the lens LE.

[0041] Numeral 107 denotes a cup attaching portion for attaching a cup 106 as a processing jig to the lens. The attaching portion 107 is comprised of a motor 131 provided inside the main body 101, a shaft 107a which rotates and moves vertically by means of a motor 132 (see Fig. 11), and an arm 107b fixed to the shaft 107a. An attaching portion 107c for fitting a proximal portion of the cup 106 is provided on the underside of a distal end of the arm 107b. The cup 106 is attached in a predetermined direction in accordance with a positioning mark provided on an upper surface of the arm 107b. When the arm 107b rotates to the position indicated by the dotted lines in conjunction with the rotation of the shaft 107a, the center of the cup 106 is adapted to arrive at the reference axis L.

[0042] In Fig. 10, numeral 110 denotes an illuminating light source. The illuminating light from the light source 110 is converted into parallel rays of light having a larger diameter than that of the lens LE by means of a collimator lens 113, and is projected onto the lens LE. The light rays which were transmitted through the lens LE further illuminate an index plate 114, so that an entire image of the lens LE as well as a grid index image of the index plate 114 subjected to the prismatic action of the lens LE are projected onto a screen plate 105. A half mirror 115 is disposed below the screen plate 105, and a first CCD camera 117a is provided on the reference axis L in the direction of its transmittance. This first CCD 117a is disposed at a position for imaging in enlarged form only a central region with the reference axis L set as a center so that the grid index image projected onto the screen plate 105 can be detected. Meanwhile, a mirror 116 as well as a second CCD camera 117b for imaging an image reflected by the mirror 116 are disposed in the reflecting direction of the half mirror 115. This second CCD 117b is disposed at a position for imaging the entire screen plate 105 so that the overall image of the lens LE projected onto the screen plate 105 can be obtained.

[0043] Fig. 11 is a diagram illustrating a controlling system of the apparatus. An image signal from the first CCD 117a is inputted to an image processing unit 134. The processing unit 134 effects image processing to detect the position of the index image projected onto the screen plate 105, and inputs the detected signal to a control unit 130. On the basis of the detected signal, the control unit 130 determines the position of the optical center of the lens LE and the direction of the axis of the cylinder (which will be described later). Meanwhile, an image signal from the second CCD 117b is inputted to an image synthesizing circuit 135, and the circuit 135 combines the image signal with characters and marks generated by a display circuit 136 connected to the control unit 130, and displays the same on the monitor 102.

[0044] Furthermore, also connected to the control unit 130 are the motor 131 for rotating the shaft 107a of the attaching portion 107, the motor 132 for vertically moving the shaft 107a, a memory 140 for storing the inputted data and the like, the switch panel 103, a frame-shape measuring device 137 for measuring the shape of an eyeglasses frame, and a processing apparatus 138 for grinding the lens LE.

[0045] A description will be given of a method of determining the position of the optical center of the lens LE and the direction of the axis of the cylinder on the basis of the image obtained by the first CCD 117a.

[0046] When the lens LE is not mounted, the grid index on the index plate 114 is illuminated by the parallel rays of light, so that the index image is projected as it is onto the screen plate 105. On the basis of the image picked up by the first CCD 117a with the lens LE not mounted, the processing unit 134 determines the coordinate positions of images of dots of the grid index, and stores the same in advance. When the lens LE is mounted, the position of the dot image located immediately below the vicinity of the optical center of the lens LE remains the same irrespective of the presence or absence of the lens LE, but the coordinate positions of the dot images at portions which are not at the optical center move due to the prismatic action of the lens LE.

[0047] Accordingly, to detect the optical center, a change in the coordinate position of each dot image with the lens LE mounted with respect to the coordinate position of each dot image with the lens LE not mounted is examined, and the position from or toward which the dot images diverge or converge as the center is determined. Namely, the center of this divergence or convergence can be detected as the optical center. In the example shown in Fig. 12, for instance, since the coordinate positions of the dot images with the lens LE not mounted converge with P0 as the center, the coordinate position of P0 can be detected as the optical center. Even if the optical center is located between dots, it suffices if the optical center is determined by interpolating the center of movement on the basis of the moving directions of the dot images and the amounts of their movement.

[0048] When the lens LE has cylindrical power, the dot images move in a direction toward (or away from) a generating line of the lens LE. Hence, the direction of the axis of the cylinder can be similarly detected by examining in which direction the dot images are moving with

respect to the coordinate positions of the dot images with the lens LE not mounted.

[0049] Next, a description will be given of the operation of the apparatus having the above-described configuration. First, after the shape of the eyeglasses frame into which the lens LE is fitted is measured in advance by the measuring device 137 connected to the main body 101, if a DATA key 103j is pressed, data on the measured frame shape (which is also referred to as the intended lens shape) is inputted. The inputted frame data is stored in the memory 140, and an intended lens shape figure 120 based on the inputted frame data is displayed on the monitor 102 (the intended lens shape for the right eye is initially displayed). The operator inputs frame-fitting conditions, including the layout of the lens with respect to the frame shape and the type of the lens, by operating the switch panel 103. The type of the lens is selected by a TYPE key 103a. Hereafter, a description will be given of cases where the types of the lenses LE to be processed are a unifocal lens, a progressive multifocal lens, and a bifocal lens, respectively.

<Unifocal Lens>

[0050] The unifocal lens mode is selected by the TYPE key 103a. Since input items for the layout of the unifocal lens are displayed on the left-hand side of the screen of the monitor 102, a highlighted cursor 121 is moved by a cursor moving key 103b to select items to be inputted. The values of the input items can be changed by a "+" "-" key 103c or a ten-key pad 103d, and layout data including FPD (the distance between geometric centers of both eyeglasses frame portions), PD (pupillary distance), and U/D (the height of the optical center with respect to the geometric center of each eyeglasses frame portion) are inputted. In addition, when the lens LE has cylindrical power, the cursor 121 is moved to the item AXIS, and the axial angle in the prescription is inputted in advance.

[0051] In addition to the intended lens shape figure 120, a cup figure 123 showing the shape of the cup 106 to be attached to the lens LE and a cross reticle 122 are both displayed on the screen of the monitor 2 (see Fig. 11) by using as the center the position on the screen corresponding to the reference axis L. The cup shape 123 is stored in advance in the memory 140. On the screen, a mark 124 shows the geometric center of the lens, and in the state prior to the mounting of the lens LE, the mark 124 and the lens shape figure 120 are displayed after being moved by using the center of the cup figure 123 (the cup attaching center) as a reference on the basis of the inputted layout data. In addition, if the data on the angle of the cylinder axis is inputted, the reticle 122 is displayed with its long axis inclined in such a manner as to conform to that angle.

[0052] Incidentally, at the time of inputting data, the layout data may be transferred to the processing apparatus 138, and the type of the lens LE (the type such as plastics and glass) and the type of the eyeglasses frame may be inputted in advance by a LENS key 103e and a FRAME key 103f, respectively, so that processing can be performed directly by using the layout data.

[0053] When necessary data have been inputted, the operator mounts the lens LE on a supporting portion 104a, and performs rough positioning such that the center of the lens LE is located in the vicinity of the center of the screen plate 105 (such that the optical center of the lens LE is located within the grid index of the index plate 114). An image of the lens LE and an index image of the index plate 114 are projected onto the screen plate 15, and the entire image of the lens LE is picked up by the second CCD 117b. Its image LE' is displayed on the screen of the monitor 102 (see Fig. 13). In addition, the index image projected onto the screen plate 115 is picked up by the first CCD 117a. That image signal is inputted to the processing unit 134, and the control unit 130 continuously obtains information on the displacement of the optical center from the reference axis L and information on the direction of the cylinder axis on the basis of information on the coordinate positions of dot images of the grid index detected by the processing unit 134.

[0054] After these items of information are obtained, a cross mark 125 showing the optical center of the lens LE is displayed by the circuit 136, as shown in Fig. 13. This mark 125 is displayed with its center conforming to the optical center of the lens LE and with its long axis inclined in such a manner as to conform to the information on the direction of the cylinder axis detected. Further, when the information on the displacement of the optical center is obtained, the lens shape figure 120 comes to be displayed by using the optical center as the reference. Namely, the lens shape figure 120 is displayed such that optical center of the lens LE and the optical center of the intended lens which is determined by the input of the layout data are aligned with each other. Since this lens shape figure 120 is displayed by being superposed on he lens image LE', by observing the two images at this stage the operator is able to instantly determine whether or not the lens diameter is lacking for processing. If the lens LE is moved, the center of the mark 125 also moves on the screen, and the lens shape figure 120 also moves correspondingly.

[0055] If there is no problem with the lens diameter, the alignment of the lens LE is effected in the following manner while further observing the display on the screen. First, in the alignment of the optical center with respect to the cup attaching center, the lens LE is moved in such a manner that the cup figure 123 is kept within the lens shape figure 120. In this state, the cup can be attached.

[0056] When the cup is attached to the lens, the cup center and the optical center are generally made to align with each other, but with this apparatus accurate alignment is not necessarily required. The reason for this is that since information on the displacement of the optical

center from the cup attaching center is already known as described above, that displacement is corrected at the time of processing on the processing apparatus 138 side. Incidentally, the reason that the alignment is effected so that the cup figure 123 is kept within the lens shape figure 120 is to ensure that the cup LE attached at the time of processing will not cause processing interference. Instead of observing the lens shape figure 120 and the cup figure 123, a region where the optical center should be located to avoid processing interference may be determined from various data by using the cup attaching center as a reference, and this region may be displayed as alignment information. In the alignment, the center of the mark 125 is made to fall within that region.

[0057] In the alignment in the direction of the axial angle, the lens LE is rotated in such a manner that the inclination of the long axis of the reticle 122 and the inclination of the long axis of the mark 125 are aligned with each other as much as possible. As for the axial angle as well, since the amount of offset with respect to the inputted axial angle can be known, that amount of offset is corrected at the time of processing on the processing apparatus 138 side. In this embodiment, however, since the lens shape figure 120 is not displayed in correspondence with the detected axial angle, if the offset of the axial angle is large, there are cases where it is impossible to accurately ascertain the processing interference due to the aforementioned positional relationship between the lens shape figure 120 and the cup figure 123. If the cup figure 123 can be sufficiently kept within the lens shape figure 120, the accurate alignment operation of the axial angle is unnecessary.

[0058] It should be noted that, the lens shape figure 120 may be displayed after being rotated by using the optical center as a reference on the basis of the information on the detected axial angle. This makes it possible to accurately confirm the processing interference due to the positional relationship between the lens shape figure 120 and the cup figure 123 without performing the alignment operation of the axial angle.

[0059] After the alignment has been made, a BLOCK key 103i is turned ON. The control unit 130 drives the motor 131 to rotate the shaft 107a so as to allow the cup 106 mounted in advance on the attaching portion 107 to arrive at the reference axis L. The control unit 130 then drives the motor 132 to lower the cup 106 and allows the lens LE to be sucked by the cup 106. At the same time, the information on the displacement of the position of the optical center and the information on the axial angle are stored in the memory 140. After the cup for the right eye lens has been attached, a switch between the right and left eye lenses is effected by pressing an R/L key 103k to attach the cup for the left eye lens. Incidentally, when the cup is attached, a job number is inputted in advance by operating a JOB key 103m and the ten-key pad 103d, thereby allowing the lens data stored in the memory 140 to be managed by the job numbers.

[0060] After the attachment of the cup, the stored data is read out by designating a job number, and is inputted to the processing apparatus 138. As the processing apparatus 138, it is possible to use the one disclosed in U.S. Pat. No. 5,716,256. In the processing apparatus 138, if the job number is inputted by an input section 138b (e.g., a work slip with a bar code attached in correspondence with the job number is read by a bar-code scanner), the lens data corresponding to the job number is read from the cup attaching apparatus body 101, and is inputted. In the processing apparatus 138, the lens LE is chucked by two lens rotating shafts 138c, and a moving mechanism 138e for changing the distance between a rotating shaft of a grinding wheel 138d for processing and the lens rotating shaft 138c is operated so as to perform processing on the basis of the inputted data. At this time, with respect to the processing data obtained from the shape data of the eyeglasses frame and layout data, a control unit 138a of the processing apparatus 138 obtains new processing data by effecting the coordinate transformation of the displacement of the position of the optical center and the offset of the axial angle when the cup is attached, and the control unit 138a controls the processing on the basis of it. Thus, even if the cup is attached to an arbitrary position, since that position is corrected, the lens LE is processed without an error. Accordingly, since accurate alignment is not required for the cup attaching apparatus body 101, even a person unskilled in the operation can speedily perform the operation very easily, and the cup attaching operation can be conducted efficiently.

[0061] Although a description has been given above of the case in which the cup is attached to an arbitrary position, it is also possible to easily effect the optical-center layout in which the cup is attached to the optical center of the lens LE as well as the frame-center layout in which the cup is attached to the geometric center of each eyeglasses frame portion.

[0062] In the case of the optical-center layout, the lens LE is moved so that the center of the mark 125 displayed on the screen is aligned with the center of the reticle 122. In the case of the frame-center layout, the lens LE is moved so that the mark 124 showing the frame center of the eyeglasses frame is aligned with the center of the reticle 122. The alignment of the angle of the cylinder axis is effected by rotating the lens LE such that, in both cases, the numerical value 126a displayed on the screen agrees with the numerical value 126b of the inputted angle thereabove, or the long axis of the mark 125 assumes the same inclination as that of the long axis of the reticle 122.

[0063] In these layouts as well, the confirmation of processability concerning the lens diameter on the basis of the lens image LE' and the lens shape figure 120, as well as the confirmation of processing interference on the basis of the cup figure 123 and the lens shape figure 120, can be performed simply.

[0064] When the lens is processed by narrowing the vertical length of the lens, i.e., when the lens is processed into the so-called crab eye lens or lens for "granny's glasses" (which is often used for eyeglasses designed especially for near use), since a cup designed especially for the crab eye lens is attached to avoid processing interference, in such a case it suffices if the shape of the cup figure 123 is displayed in the crab eye shape.

<Progressive Multifocal Lens>

[0065] The progressive multifocal lens mode is selected by the TYPE key 103a, and layout data for the progressive multifocal lens is inputted. Since the progressive multifocal lens is provided with the layout marks indicating such as the eyepoint for far use and the horizontal direction, the layout mark images together with the lens image are clearly projected onto the screen plate 105, and these images are picked up by the second CCD 117b and are displayed on the monitor 102.
[0066] Fig. 14 shows an example of the screen at this time, and the lens shape figure 120 in this mode is displayed after being moved on the basis of the inputted layout data by using the center of the cup figure 123 (cup attaching center) as a reference. Reference numeral 150 denotes an image of the eyepoint mark for far use, and numeral 151 denotes an image of the horizontal line mark. Alignment is effected by moving the lens LE in such a manner that these images are superposed on the reticle 122. After completing the alignment, the operator confirms the processability concerning the lens diameter through comparison of the lens image LE' with the lens shape figure 120, confirms processing interference through comparison of the cup figure 123 and the lens shape figure 120, and then presses the BLOCK key 103i to attach the cup 106.

<Bifocal Lens>

[0067] The bifocal lens mode is selected by the TYPE key 103a. As shown in Fig. 15, a small lens portion layout mark 145 is displayed at a predetermined position on the screen with respect to the cup attaching center (e.g., in the case of the right eye use, a small lens upper side center 145a is located at a position offset about 5 mm toward the right side and the lower side, respectively, with respect to the cup attaching center). The layout data is inputted by operating the panel switch 103 in accordance with the input items displayed on the left-hand side. In an item 153, the pupillary distance for near use is entered. In an item 154, the distance from the center of the upper line of the small lens portion to the bottom side of the lens immediately therebelow (that is to say, the height of the small lens portion) is entered. As a result, the display position of the lens shape figure 120 is determined.
[0068] The alignment of the bifocal lens is performed as follows. Although the small lens image of the bifocal lens is shot only unclearly even if the lens is shot directly, if the lens is illuminated by parallel rays of light, the small lens image of the bifocal lens is clearly projected onto the screen plate 105. As this image is picked up by the second CCD 117b, a clear small lens image is displayed on the monitor 102. The operator moves the lens LE such that a displayed small lens image 152 is superposed on the mark 145, and such that an upper center of the small lens image 152 is superposed on the small lens upper side center 145a of the mark 145. This completes the alignment, so that the operator confirms the processability concerning the lens diameter through comparison of the lens image LE' with the lens shape figure 120, confirms processing interference through comparison of the cup figure 123 and the lens shape figure 120, and then presses the BLOCK key 103i to attach the cup 106.
[0069] As described above, in accordance with the present invention, alignment for attaching a cup in the unifocal lens, the multifocal lens or the like which are not provided with marked points can be performed easily. With respect to the unifocal lense, in particular, even a person unskilled in the operation is able to speedily perform the alignment operation very easily, and is able to reduce processing errors. For this reason, the cup attaching operation can be conducted efficiently.
[0070] In addition, the confirmation of processability concerning the lens diameter and the confirmation of processing interference at the cup attaching portion can be performed simply.

Claims

1. A cup attaching apparatus comprising:

   attaching means having a reference axis to attach a cup as a processing jig to a subject lens along the reference axis;
   illuminating means for illuminating the lens and an index plate having an index of a predetermined pattern by means of substantially parallel rays of light;
   index detecting means for detecting an image of the index formed by said illuminating means;
   optical-center sensing means for obtaining an optical center of the lens with respect to the reference axis on the basis of a result of detection by said index detecting means; and
   position storing means for storing information on a position of the optical center obtained by said optical-center sensing means when said cup is attached to the lens by said attaching means,
   wherein the information on the position of the optical center stored by said storage means is used as information on correction at the time of

processing by an eyeglass lens processing apparatus.

2. The cup attaching apparatus according to claim 1, wherein the index includes a grid index.

3. The cup attaching apparatus according to claim 1, further comprising:

shape storing means for storing a shape of the cup which is attached to the lens;
input means for inputting data on a shape of an eyeglasses frame into which the lens is fitted and data on layout of the lens with respect to the eyeglasses frame; and
display means for displaying alignment information for avoiding processing interference, on the basis of the cup shape stored by said shape storing means, the frame shape based on the data inputted by said input means, and a relative position of the optical center obtained by said optical-center sensing means with respect to the reference axis.

4. The cup attaching apparatus according to claim 3, wherein said display means displays the cup shape in such a manner as to have a predetermined positional relationship with the reference axis, and displays the frame shape such that an optical center of the frame shape is located at the position of the optical center obtained by said optical-center sensing means.

5. The cup attaching apparatus according to claim 4, further comprising:

reticle forming means for forming on display by said display means a reticle for alignment having a predetermined positional relationship with the reference axis; and
graphic-figure forming means for forming a graphic figure indicating a position of the optical center or a frame center of the frame shape.

6. The cup attaching apparatus according to claim 3, wherein said display means displays a region for aligning the optical center obtained by said optical-center sensing means with respect to the reference axis.

7. The cup attaching apparatus according to claim 3, wherein said display means displays a region for aligning the optical center obtained by said optical-center sensing means with respect to the reference axis,

said cup attaching apparatus further comprising:

reticle forming means for forming on display by said display means a reticle for alignment having a predetermined positional relationship with the reference axis; and
graphic-figure forming means for forming a graphic figure indicating a position of the optical center or a frame center of the frame shape.

8. The cup attaching apparatus according to claim 1, further comprising:

cylinder-axis sensing means for obtaining a direction of a cylinder axis of the lens on the basis of a result of detection by said index detecting means;
input means for inputting data on an angle of the cylinder axis obtained by prescription;
displacement detecting means for obtaining information on displacement in a direction of the cylinder axis obtained by said cylinder-axis sensing means with respect to the angle of the cylinder axis inputted by said input means; and
displacement storing means for storing the displacement information obtained by said displacement detecting means when the cup is attached to the lens by said attaching means,
wherein the displacement information stored by said displacement storing means is also used as information on correction at the time of processing by said eyeglass lens processing apparatus.

9. The cup attaching apparatus according to claim 1, further comprising:

cylinder-axis sensing means for obtaining a direction of a cylinder axis of the lens on the basis of a result of detection by said index detecting means;
input means for inputting data on an angle of the cylinder axis obtained by prescription; and
display means for displaying information on the direction of the cylinder axis obtained by said cylinder-axis sensing means and information on the angle of the cylinder axis inputted by said input means,
wherein alignment in the direction of the cylinder axis is effected while observing display by said display means.

10. The cup attaching apparatus according to claim 1, further comprising:

a screen for projecting an image of the lens formed by said illuminating means;
imaging means for picking up an entire image of the lens projected onto said screen;
input means for inputting data on a shape of an

eyeglasses frame into which the lens is fitted and data on layout of the lens with respect to the eyeglasses frame;
display means for displaying in a superposed manner the image picked up by said imaging means and a frame shape based on the data inputted by said input means; and
display controlling means for controlling display on the frame shape such that an optical center of the frame shape is located at the position of the optical center obtained by said optical-center sensing means.

11. The cup attaching apparatus according to claim 1, further comprising:

a screen for projecting an image of the lens formed by said illuminating means;
imaging means for picking up an entire image of the lens projected onto said screen;
display means for displaying the image picked up by said imaging means;
display controlling means for controlling display by said display means for displaying a reticle having a predetermined relationship with the reference axis; and
selecting means for selecting a type of the lens, wherein when a progressive multifocal lens is selected by said selecting means, said display controlling means causes an image of a layout mark of the progressive multifocal lens to be displayed on the display by said display means, and alignment is effected while observing the layout mark image and the reticle displayed by said display means.

12. The cup attaching apparatus according to claim 1, further comprising:

a screen for projecting an image of the lens formed by said illuminating means;
imaging means for picking up an entire image of the lens projected onto said screen;
display means for displaying the image picked up by said imaging means;
input means for inputting data on layout of the lens with respect to an eyeglasses frame;
selecting means for selecting a type of the lens; and
display controlling means for controlling display by said display means for displaying a small lens mark for aligning a small lens of a bifocal lens on the basis of the layout data inputted by said input means when the bifocal lens is selected by said selecting means,
wherein alignment is effected while observing the small lens mark and an image of the small lens displayed by said display means.

FIG. 1

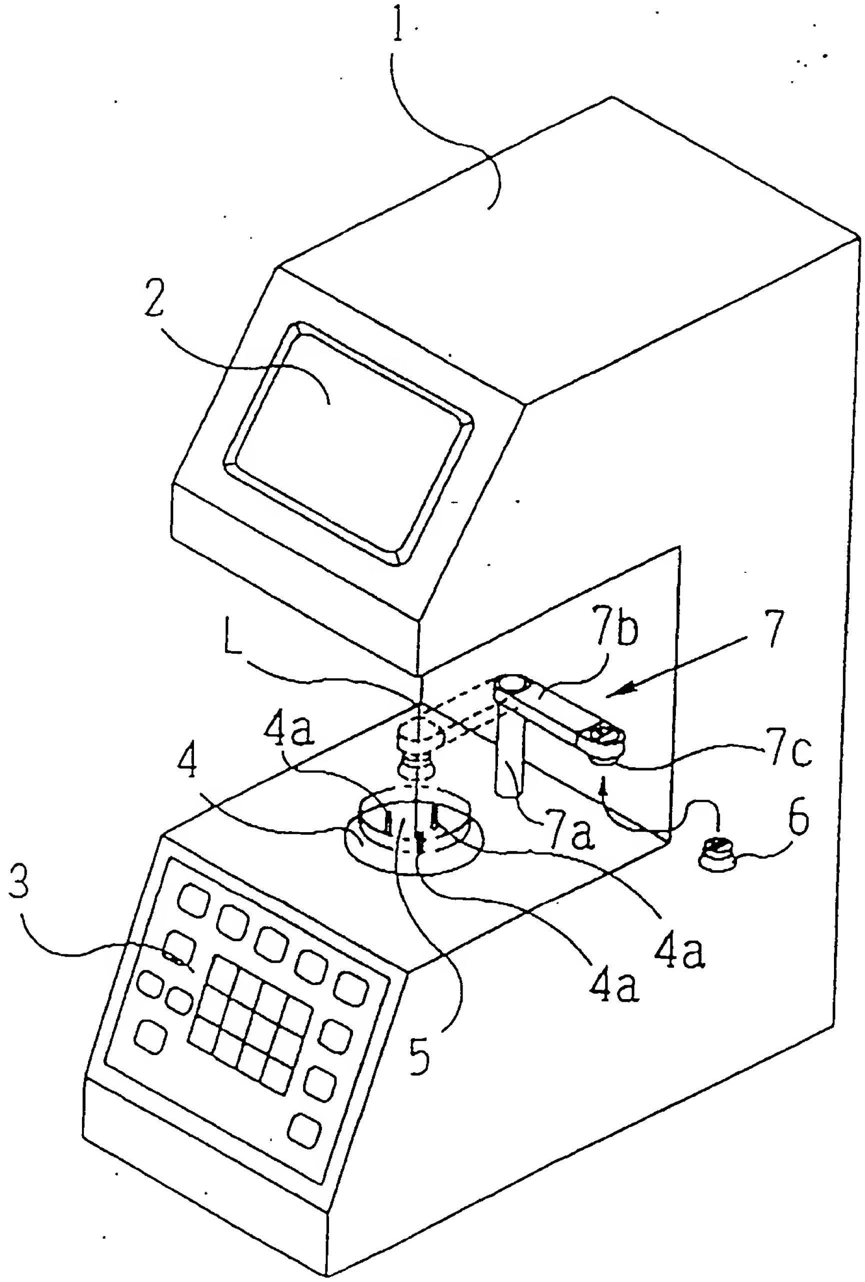
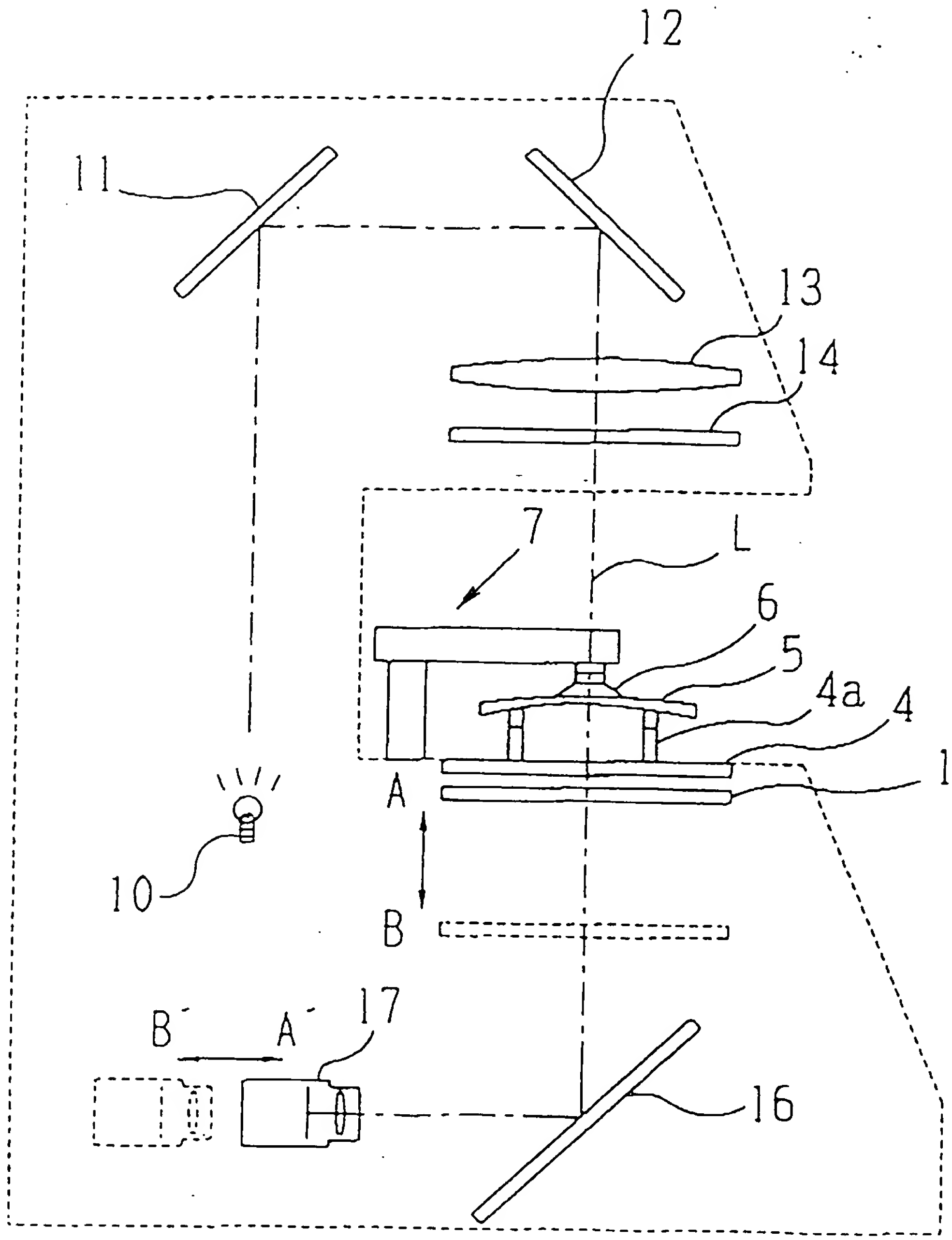
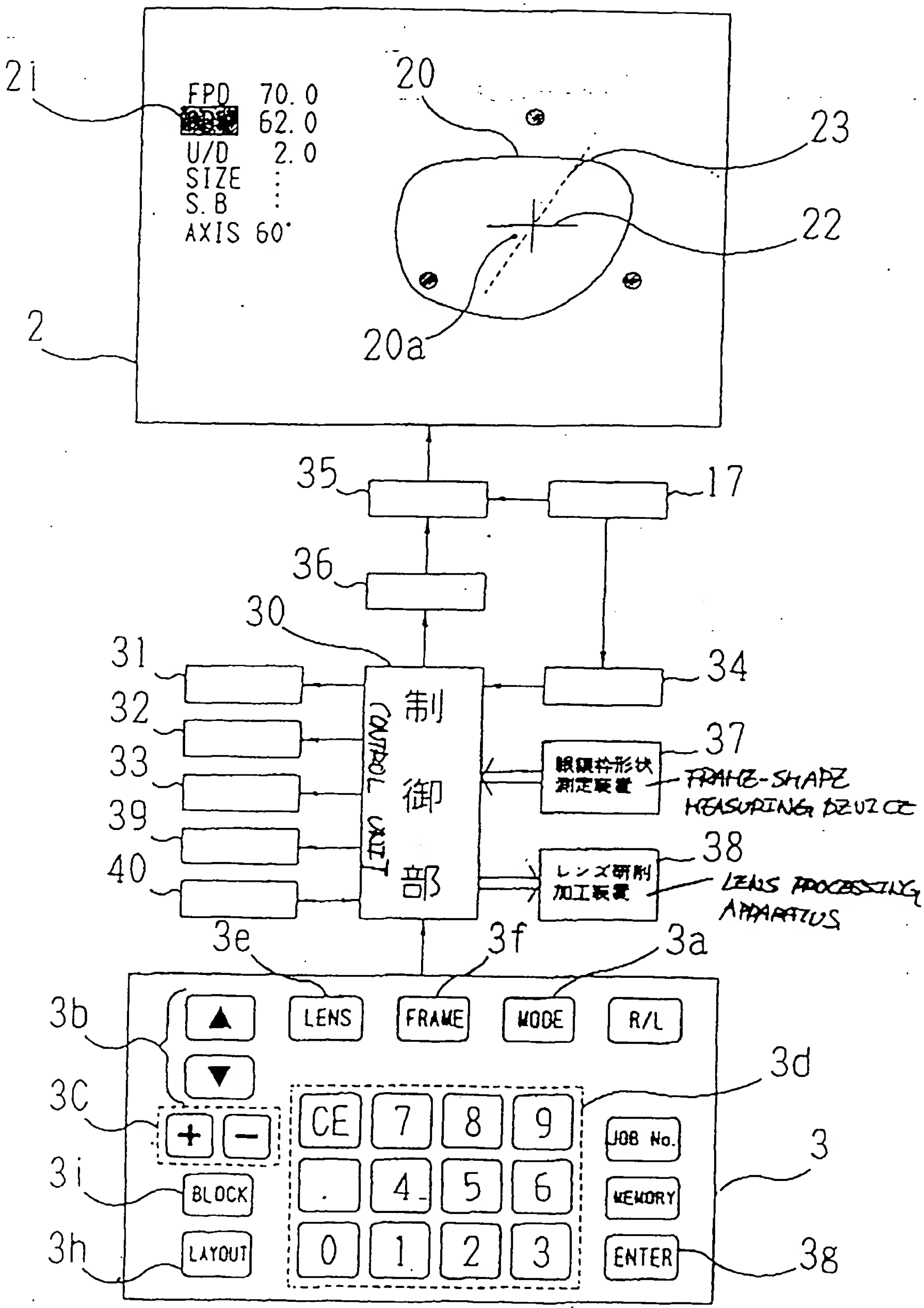


FIG. 2





2i
FPD 70.0
62.0
U/D 2.0
SIZE :
S.B :
AXIS 60°
20
23
22
20a
2
35
17
36
30
31
32
33
39
40
制御部
CONTROL UNIT
34
37
眼鏡枠形状測定装置
FRAME-SHAPE MEASURING DEVICE
38
レンズ研削加工装置
LENS PROCESSING APPARATUS
3e
3f
3a
3b
LENS
FRAME
MODE
R/L
3d
3C
CE 7 8 9
. 4 5 6
0 1 2 3
JOB No.
MEMORY
ENTER
BLOCK
LAYOUT
3i
3h
3
3g

FIG. 3

FIG. 4

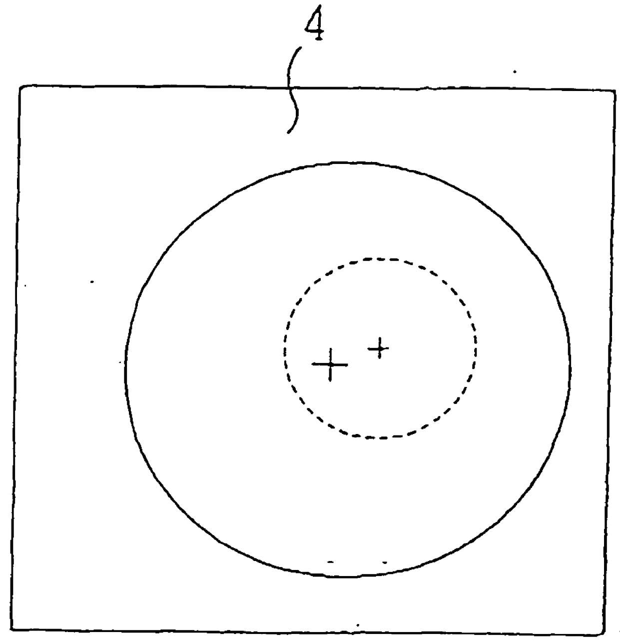


FIG. 5

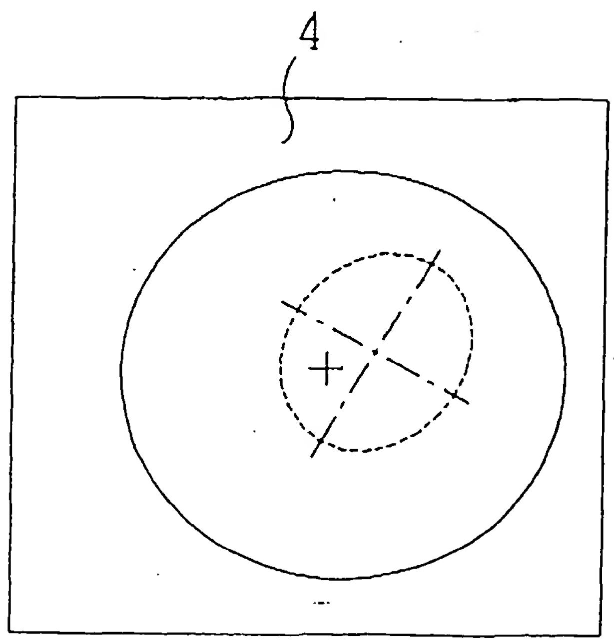
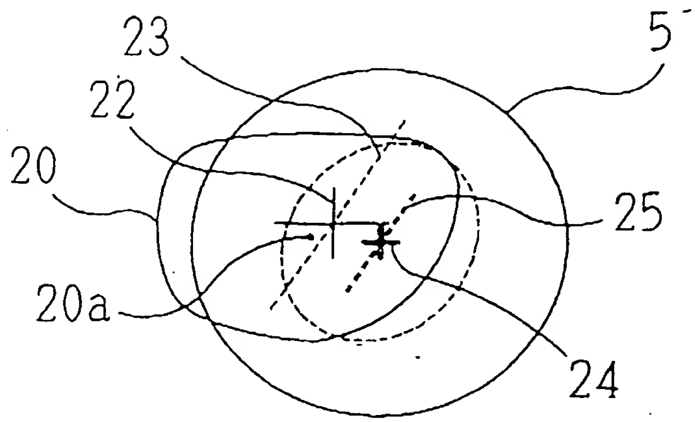


FIG. 6

(a)



(b)

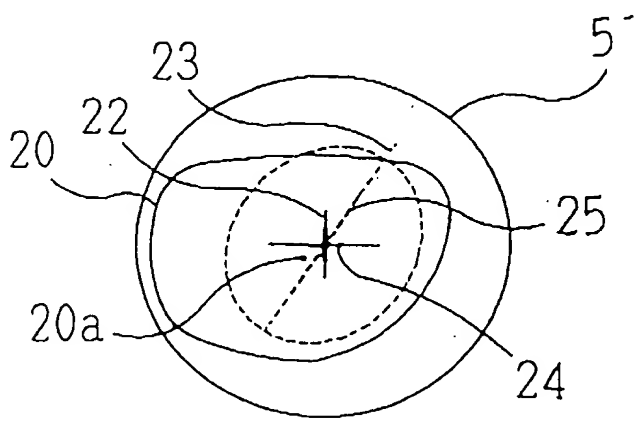


FIG. 7

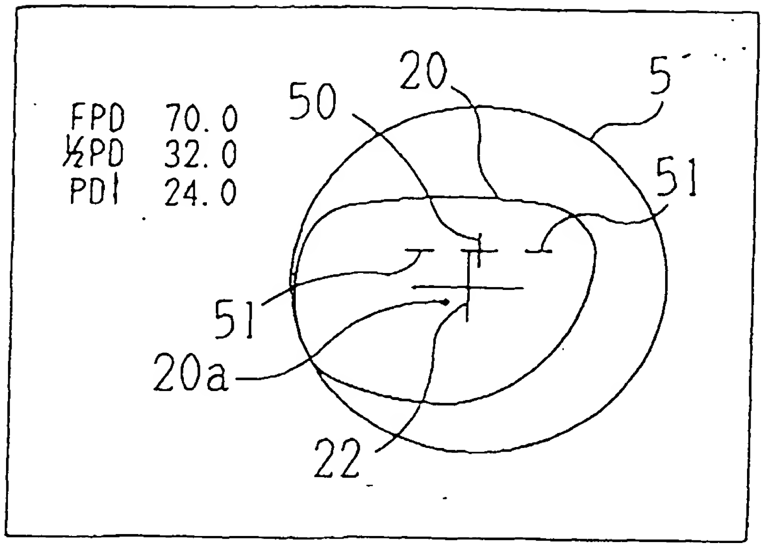

FPD 70.0
½PD 32.0
PDI 24.0
50
20
5
51
51
20a
22

FIG. 8

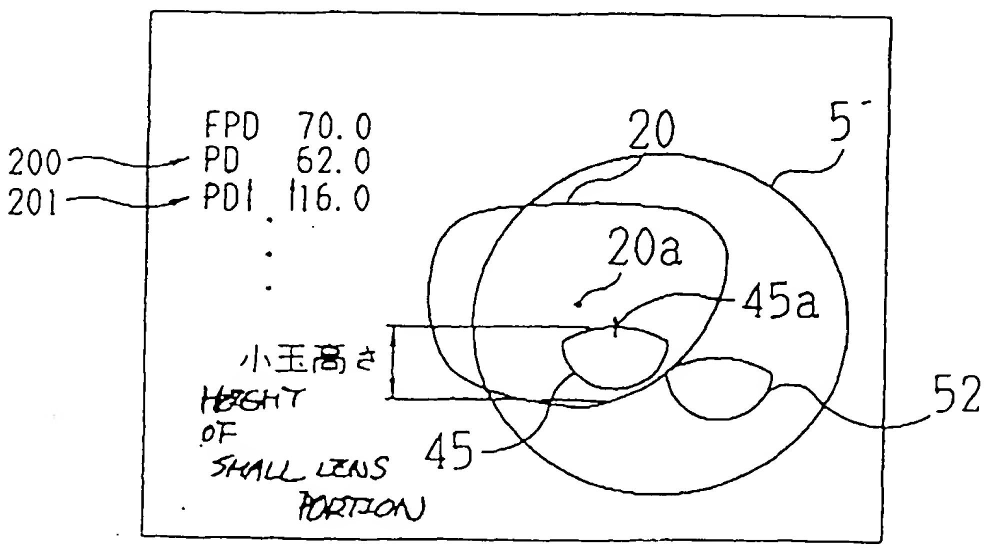
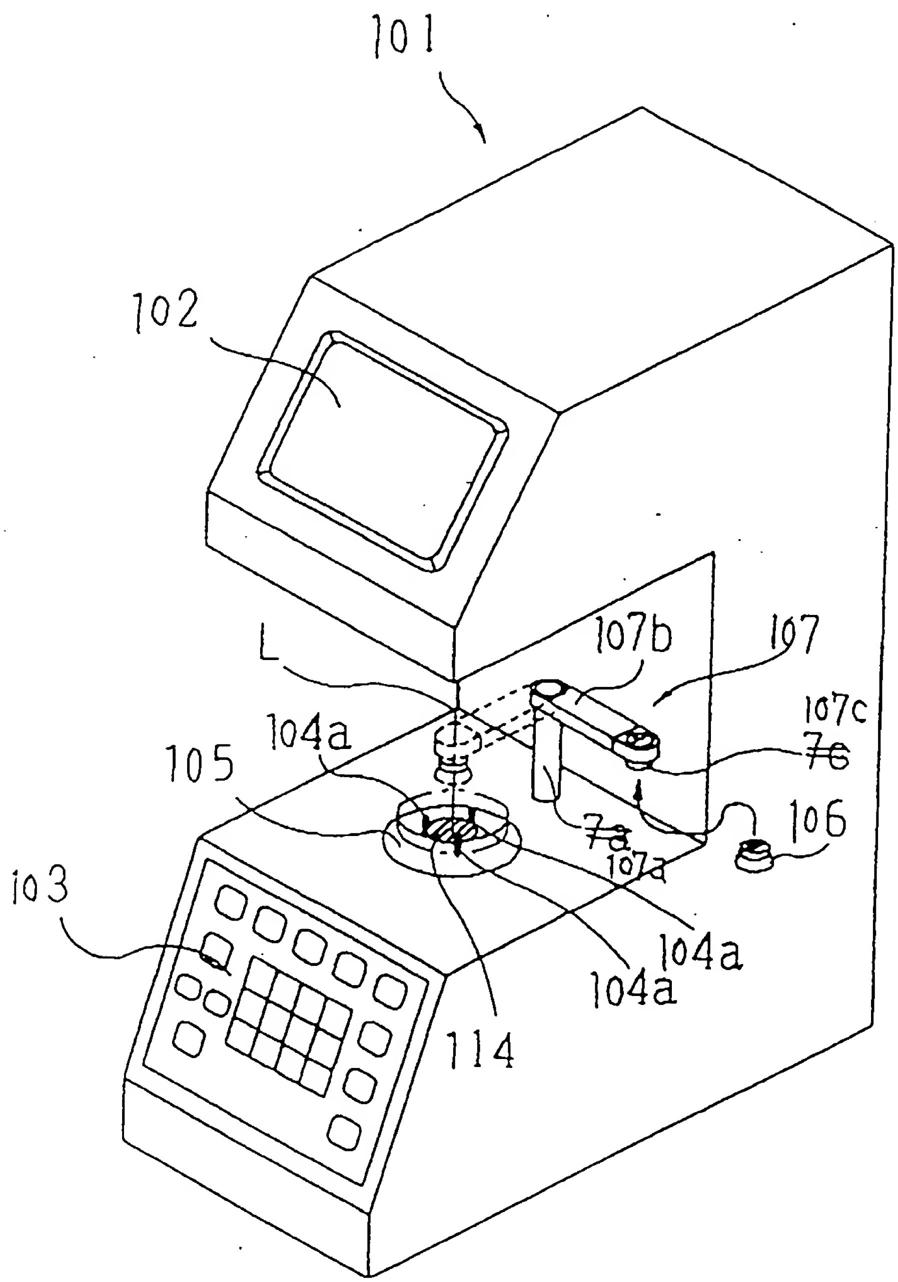

FPD 70.0
PD 62.0
PDI 116.0
200
201
20
5
20a
45a
小玉高さ
HEIGHT OF SMALL LENS PORTION
45
52

FIG. 9


101
102
L
107b
107
107c
~~7c~~
104a
105
~~7a~~
107a
106
103
104a
104a
114

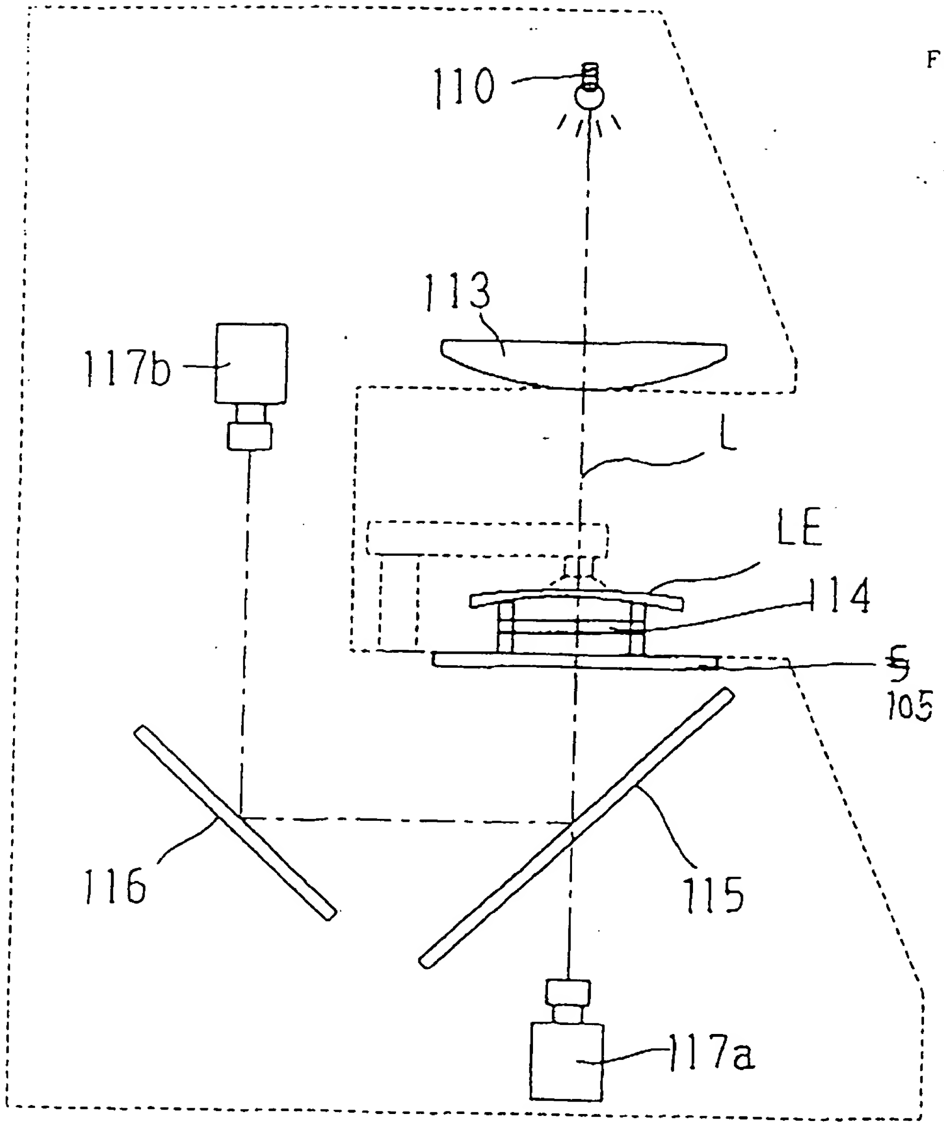
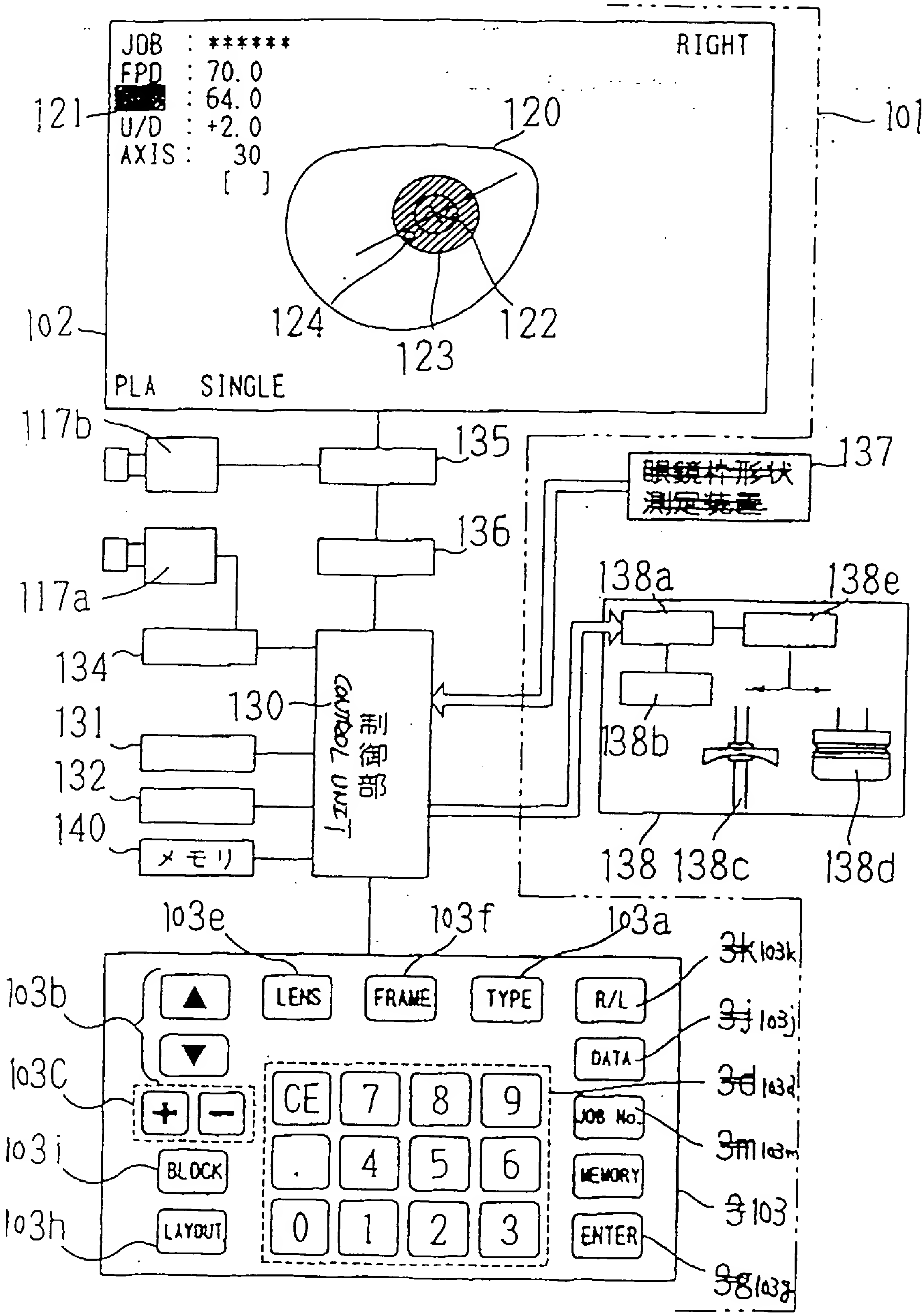


FIG. 10

FIG. 11


JOB : ******
RIGHT
FPD : 70.0
: 64.0
U/D : +2.0
AXIS : 30
[ ]
PLA SINGLE
120
121
122
123
124
101
102
117a
117b
130
制御部
CONTROL UNIT
131
132
134
135
136
137
~~眼鏡枠形状測定装置~~
138
138a
138b
138c
138d
138e
140
メモリ
LENS
FRAME
TYPE
R/L
DATA
CE
JOB No.
MEMORY
ENTER
BLOCK
LAYOUT
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103a
103b
103C
103d
103e
103f
103g
103h
103i
103j
103k
103m

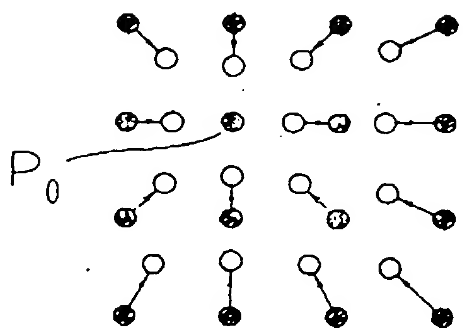
P0

FIG. 12

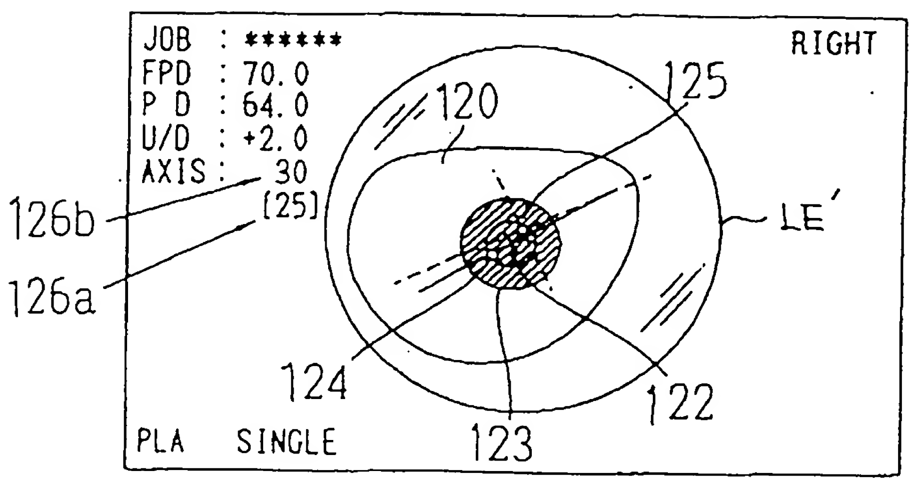
JOB : ******
FPD : 70.0
P D : 64.0
U/D : +2.0
AXIS : 30
[25]
RIGHT
120
125
LE'
126b
126a
124
122
123
PLA SINGLE

FIG. 13

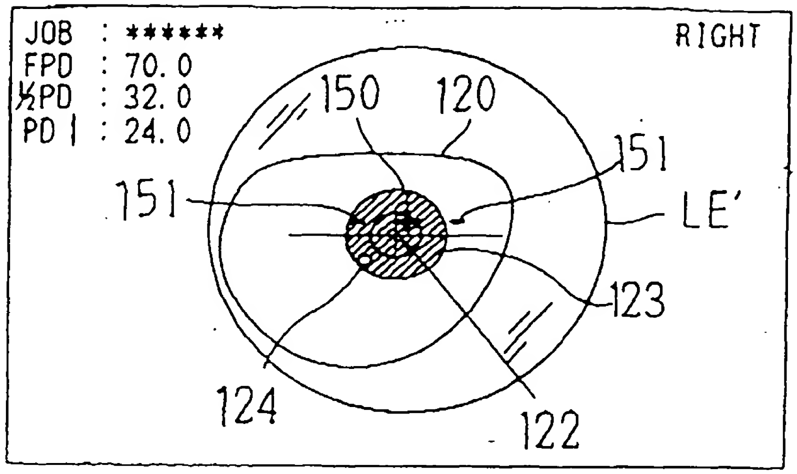
JOB : ******
FPD : 70.0
½PD : 32.0
PD| : 24.0
RIGHT
150
120
151
151
LE'
123
124
122

FIG. 14

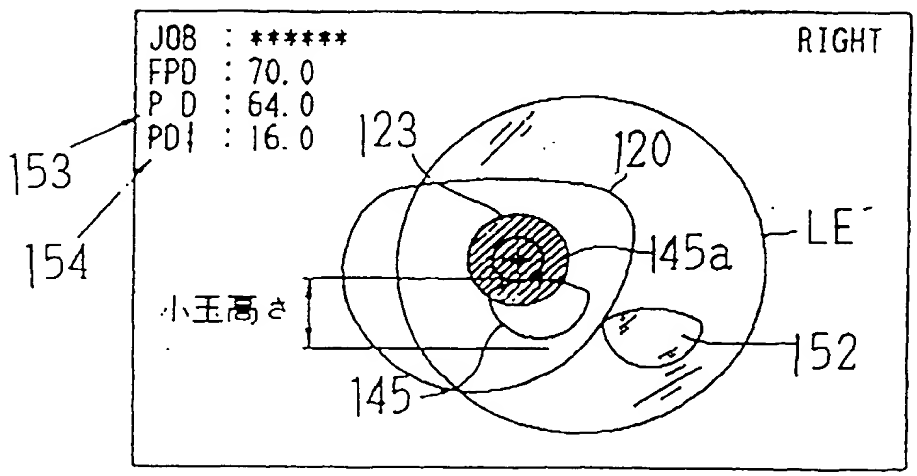
JOB : ******
FPD : 70.0
P D : 64.0
PD| : 16.0
RIGHT
153
154
123
120
LE'
145a
小玉高さ
152
145

FIG. 15

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 99 10 1573

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
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TECHNICAL FIELDS SEARCHED (Int.Cl.6)
B24B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	4 May 1999	Garella, M

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04-05-1999

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